

KEY

## Mole Calculation Practice Worksheet

Answer the following questions:

- 1) How many moles are in 25 grams of water?
- 2) How many grams are in 4.5 moles of  $\text{Li}_2\text{O}$ ?
- 3) How many molecules are in 23 moles of oxygen?
- 4) How many moles are in  $3.4 \times 10^{23}$  molecules of  $\text{H}_2\text{SO}_4$ ?
- 5) How many molecules are in 25 grams of  $\text{NH}_3$ ?
- 6) How many grams are in  $8.2 \times 10^{22}$  molecules of  $\text{N}_2\text{I}_6$ ?

## Mole Calculation Practice Worksheet

Answer the following questions:

- 1) How many moles are in 25 grams of water?

$$25\text{g H}_2\text{O} \times \frac{1\text{mol}}{18\text{g H}_2\text{O}} = 1.4\text{ mol H}_2\text{O}$$

- 2) How many grams are in 4.5 moles of  $\text{Li}_2\text{O}$ ?

$$4.5\text{mol Li}_2\text{O} \times \frac{29.88\text{g}}{1\text{mol}} = 134\text{g Li}_2\text{O}$$

- 3) How many molecules are in 23 moles of oxygen?

$$23\text{mol O}_2 \times \frac{6.02 \times 10^{23}\text{O}_2}{1\text{mol O}_2} = 1.4 \times 10^{25}\text{mol O}_2$$

- 4) How many moles are in  $3.4 \times 10^{23}$  molecules of  $\text{H}_2\text{SO}_4$ ?

$$3.4 \times 10^{23}\text{H}_2\text{SO}_4 \times \frac{1\text{mol}}{6.02 \times 10^{23}\text{H}_2\text{SO}_4} = 0.56\text{mol H}_2\text{SO}_4$$

- 5) How many molecules are in 25 grams of  $\text{NH}_3$ ?

$$25\text{g NH}_3 \times \frac{1\text{mol}}{17\text{g NH}_3} \times \frac{6.02 \times 10^{23}\text{NH}_3}{1\text{mol}} = 8.9 \times 10^{23}\text{NH}_3$$

- 6) How many grams are in  $8.2 \times 10^{22}$  molecules of  $\text{N}_2\text{I}_6$ ?

$$8.2 \times 10^{22}\text{N}_2\text{I}_6 \times \frac{1\text{mol N}_2\text{I}_6}{6.02 \times 10^{23}} \times \frac{789.4\text{g}}{1\text{mol N}_2\text{I}_6} = 107.5\text{g N}_2\text{I}_6$$

## Moles Worksheet

- 1) Define "mole".
- 2) How many moles are present in 34 grams of  $\text{Cu}(\text{OH})_2$ ?
- 3) How many moles are present in  $2.45 \times 10^{23}$  molecules of  $\text{CH}_4$ ?
- 4) How many grams are there in  $3.4 \times 10^{24}$  molecules of  $\text{NH}_3$ ?
- 5) How much does 4.2 moles of  $\text{Ca}(\text{NO}_3)_2$  weigh?
- 6) What is the molar mass of  $\text{MgO}$ ?
- 7) How are the terms "molar mass" and "atomic mass" different from one another?
- 8) Which is a better unit for expressing molar mass, "amu" or "grams/mole"?

## Moles Worksheet

- 1) Define "mole".

$6.02 \times 10^{23}$  of anything!

- 2) How many moles are present in 34 grams of  $\text{Cu}(\text{OH})_2$ ?

$$34\text{g Cu}(\text{OH})_2 \times \frac{1\text{mol Cu}(\text{OH})_2}{97.55\text{g}} = 0.35\text{mol Cu}(\text{OH})_2$$

ions  
molecules  
F.V.

- 3) How many moles are present in  $2.45 \times 10^{23}$  molecules of  $\text{CH}_4$ ?

$$2.45 \times 10^{23} \text{CH}_4 \times \frac{1\text{mol CH}_4}{6.02 \times 10^{23} \text{molecules}} = 0.41\text{mol CH}_4$$

- 4) How many grams are there in  $3.4 \times 10^{24}$  molecules of  $\text{NH}_3$ ?

$$3.4 \times 10^{24} \text{NH}_3 \times \frac{1\text{mol NH}_3}{6.02 \times 10^{23} \text{molecules}} \times \frac{17\text{g}}{1\text{mol NH}_3} =$$

- 5) How much does 4.2 moles of  $\text{Ca}(\text{NO}_3)_2$  weigh?

$$4.2\text{mol Ca}(\text{NO}_3)_2 \times \frac{164\text{g}}{1\text{mol Ca}(\text{NO}_3)_2} = 689\text{g Ca}(\text{NO}_3)_2$$

- 6) What is the molar mass of  $\text{MgO}$ ?

$$\begin{array}{r} 24.31\text{g Mg} \\ + 16.00\text{g O} \\ \hline \end{array}$$

40.31g MgO

- 7) How are the terms "molar mass" and "atomic mass" different from one another?

mass of a mole of something - atom, compound  $\text{g/mol}$  - mass of an individual atom

- 8) Which is a better unit for expressing molar mass, "amu" or "grams/mole"?

$\text{g/mol}$

amu

## chapter 11 work sheet 1

1.

How many molecules are contained in each of the following?

- a. 1.35 mol carbon disulfide ( $\text{CS}_2$ )
- b. 0.254 mol diarsenic trioxide ( $\text{As}_2\text{O}_3$ )

2.

How many moles contain each of the following?

- a.  $1.25 \times 10^{15}$  molecules carbon dioxide
- b.  $3.59 \times 10^{21}$  formula units sodium nitrate

3.

How many moles are in 100.0 g of each of the following compounds?

- a. dinitrogen oxide ( $\text{N}_2\text{O}$ )
- b. methanol ( $\text{CH}_3\text{OH}$ )

4. \_\_\_\_\_

Make the following conversions.

- a. 3.50 mol Li to g Li
- b. 7.65 g Co to mol Co

5. \_\_\_\_\_

How many moles of ions are in the following?

- a. 0.0200 g  $\text{AgNO}_3$
- b. 0.100 mol  $\text{K}_2\text{CrO}_4$
- c. 0.500 g  $\text{Ba}(\text{OH})_2$

1a.

$$1.35 \text{ mol CS}_2 \times \frac{6.02 \times 10^{23} \text{ molec.}}{1 \text{ mol CS}_2} =$$

$$8.13 \times 10^{23} \text{ molec CS}_2$$

b.

$$0.254 \text{ mol As}_2\text{O}_3 \times \frac{6.02 \times 10^{23} \text{ molec.}}{1 \text{ mol As}_2\text{O}_3} =$$

$$1.53 \times 10^{23} \text{ molec As}_2\text{O}_3$$

2a.

$$1.25 \times 10^{15} \text{ molec. CO}_2 \times \frac{1 \text{ mol CO}_2}{6.02 \times 10^{23} \text{ molec.}} =$$

$$2.08 \times 10^{-9} \text{ mol CO}_2$$

b.

$$3.59 \times 10^{21} \text{ f.u. NaNO}_3 \times \frac{1 \text{ mol NaNO}_3}{6.02 \times 10^{23} \text{ f.u.}} =$$

$$5.96 \times 10^{-3} \text{ mol NaNO}_3$$

$$\begin{array}{r}
 3a. \quad 2(14.00g) N \\
 \quad 16.00g O \\
 \hline
 \quad 44.00g N_2O \\
 \quad \text{mol}
 \end{array}$$

$$100.00g N_2O \times \frac{1 \text{ mol } N_2O}{44.00g} = 2.27 \text{ mol } N_2O$$

$$\begin{array}{r}
 b. \quad 12.01g C \\
 \quad 4(1.01g) H \\
 \quad 16.00g O \\
 \hline
 \quad 32.05g CH_3OH \\
 \quad \text{mol}
 \end{array}$$

$$100.00g CH_3OH \times \frac{1 \text{ mol } CH_3OH}{32.05g} =$$

$$3.13 \text{ mol } CH_3OH$$

4) a.  $3.50 \text{ mol Li} \times \frac{6.941 \text{ g Li}}{1 \text{ mol Li}} = 24.3 \text{ g Li}$

b.  $7.65 \text{ g Co} \times \frac{1 \text{ mol Co}}{58.933 \text{ g}} = 0.130 \text{ g Co}$

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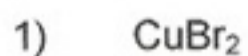
5) a.  $0.0200 \text{ g AgNO}_3 \times \frac{1 \text{ mol AgNO}_3}{169.87 \text{ g}}$   
 $\times \frac{2 \text{ mol ions}}{1 \text{ mol AgNO}_3} = 2.35 \times 10^{-4} \text{ mol ion}$

b.  $0.100 \text{ mol K}_2\text{CrO}_4 \times \frac{3 \text{ mol ions}}{1 \text{ mol K}_2\text{CrO}_4} =$   
 $0.300 \text{ mol ions}$

c.  $0.500 \text{ g Ba(OH)}_2 \times \frac{1 \text{ mol Ba(OH)}_2}{171.33 \text{ g}}$   
 $\times \frac{3 \text{ mol ions}}{1 \text{ mol Ba(OH)}_2} = 8.75 \times 10^{-3} \text{ mol ions}$

## Percent Composition Worksheet - Solutions

Find the percent compositions of all of the elements in the following compounds:



Cu:

Br:

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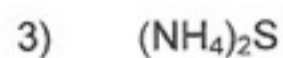


Na:

O:

H:

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N:

H:

S:

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N:

S:

## Percent Composition Worksheet - Solutions

Find the percent compositions of all of the elements in the following compounds:

1)  $\text{CuBr}_2$

$\text{Cu} - 63.55 \text{ g/mol}$	$\frac{63.55}{223.5} \times 100 = 28.47\%$	
$2\text{Br} - 2(79.9 \text{ g/mol})$	$\frac{2(79.9)}{223.4} \times 100$	Cu: <span style="color: green;">28.47%</span>
$\text{CuBr}_2 - 223.4 \text{ g/mol}$		Br: <span style="color: green;">71.6%</span>

2)  $\text{NaOH}$

$\text{Na} - 23 \text{ g/mol}$	$\% \text{Na} = \frac{23}{40} \times 100 = 57.5$	
$\text{O} - 16 \text{ g/mol}$	$\% \text{O} = \frac{16}{40} \times 100 =$	Na: <span style="color: green;">57.5%</span>
$\text{H} - 1 \text{ g/mol}$	$\% \text{H} = \frac{1}{40} \times 100 =$	O: <span style="color: green;">40.0%</span>
$\text{NaOH} - 40 \text{ g/mol}$		H: <span style="color: green;">2.5%</span>

3)  $(\text{NH}_4)_2\text{S}$

$\text{N} - 2(14)$	$\frac{28}{68} \times 100 =$	
$\text{H} - 8(1)$	$\frac{8}{68} \times 100 =$	N: <span style="color: green;">41.1%</span>
$\text{S} - 32 \text{ g/mol}$	$\frac{32}{68} \times 100 =$	H: <span style="color: green;">11.8%</span>
$(\text{NH}_4)_2\text{S} - 68 \text{ g/mol}$		S: <span style="color: green;">47.1%</span>

4)  $\text{N}_2\text{S}_2$

$\text{N} - 2(14 \text{ g})$	$\frac{28}{92} \times 100 =$	
$\text{S} - 2(32 \text{ g})$	$\frac{64}{92} \times 100 =$	N: <span style="color: green;">30.4%</span>
$\text{N}_2\text{S}_2 - 92 \text{ g/mol}$		S: <span style="color: green;">69.6%</span>

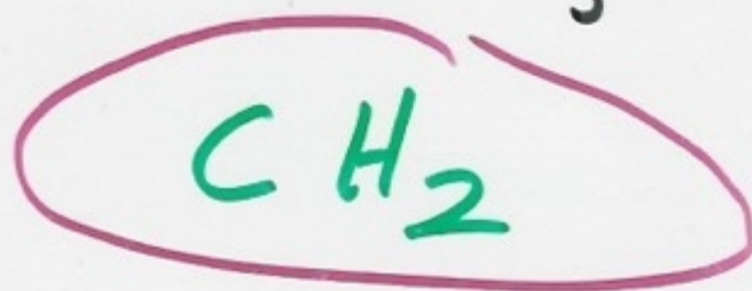
work sheet #2

Name

1. 2-Methylpropene is a compound used to make synthetic rubber. A sample of 2-methylpropene contains 0.556 g C and 0.0933 g H. Determine its empirical formula.
2. Benzoic acid is a compound used as a food preservative. The compound contains 68.8% C, 4.95% H, and 26.2% O by mass. What is its empirical formula?
3. Freons are gaseous compounds used in refrigeration. A particular Freon contains 9.93% carbon, 58.6% chlorine, and 31.4% fluorine by mass. What is the empirical formula of this Freon?
4. The molecular mass of benzene, an important industrial solvent, is 78.0 u and its empirical formula is CH. What is the molecular formula for benzene? Benzene is a proven carcinogen.
5. Aspirin contains 60.0% carbon, 4.48% hydrogen, and 35.5% oxygen. It has a molecular mass of 180 u. What are its empirical and molecular formulas?

$$1) \quad 0.556 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g}} = \frac{.0463 \text{ mol C}}{.0463} = 1$$

$$0.0933 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g}} = \frac{.0923 \text{ mol H}}{.0463} = 2$$



$$\begin{array}{rcl}
 2) \quad 68.8\% \text{ C} & : & 68.8 \text{ g C} \\
 4.95\% \text{ H} & : & 4.95 \text{ g H} \\
 26.2\% \text{ O} & : & 26.2 \text{ g O} \\
 \hline
 100 \text{ g sample}
 \end{array}$$

$$68.8 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g}} = \frac{5.73 \text{ mol C}}{1.64} = 3.5 \times 2$$

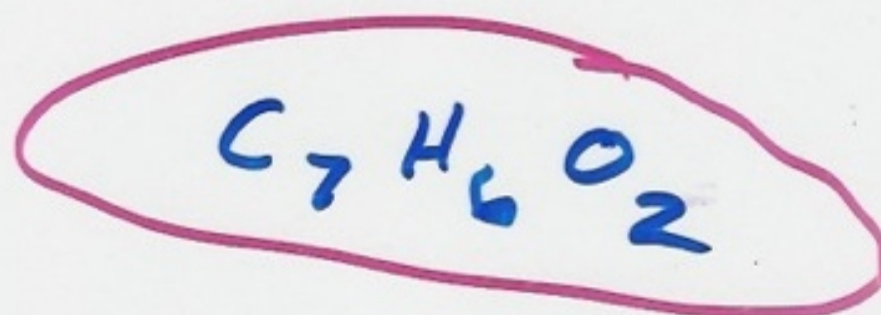
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$$4.95 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g}} = \frac{4.91 \text{ mol H}}{1.64 \text{ mol}} = 3 \times 2$$

6

$$26.2 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g}} = \frac{1.64 \text{ mol O}}{1.64 \text{ mol}} = 1 \times 2$$

2



#3

$$9.93\% \text{ C} = 9.93 \text{ g C}$$

$$58.6\% \text{ Cl} : 58.6 \text{ g Cl}$$

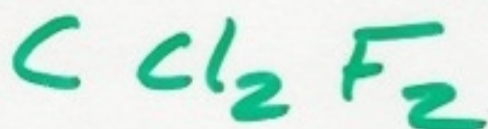
$$31.4\% \text{ F} : 31.4 \text{ g F}$$

100 g sample

$$9.93 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g}} = \frac{0.827 \text{ mol C}}{0.827 \text{ mol}} = 1$$

$$58.6 \text{ g Cl} \times \frac{1 \text{ mol Cl}}{35.45 \text{ g}} = \frac{1.65 \text{ mol Cl}}{0.827 \text{ mol}} = 2$$

$$31.4 \text{ g F} \times \frac{1 \text{ mol F}}{19.00 \text{ g}} = \frac{1.65 \text{ mol F}}{0.827 \text{ mol}} = 2$$



#4 CH - Empirical Formula

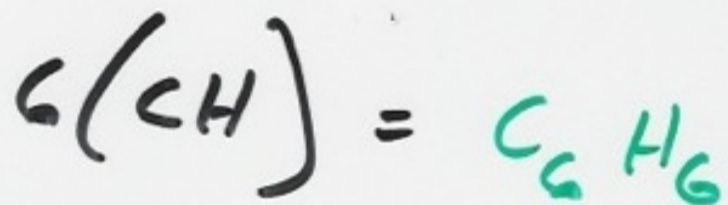
12u C

1u H

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13u - Empirical mass

$$\frac{78u}{13u} = 6 \quad \text{— molecular mass}$$

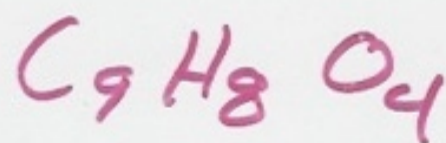
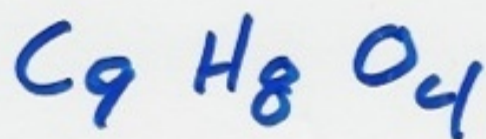


$$\begin{array}{rcl}
 \#5) & 60.0\% \text{ C} & = 60.0\text{g C} \\
 & 4.48\% \text{ H} & = 4.48\text{g H} \\
 & 35.5\% \text{ O} & = 35.5\text{g O} \\
 \hline
 & 100\text{g sample} & 
 \end{array}$$

$$60.0\text{g C} \times \frac{1\text{mol C}}{12.01\text{g}} = \frac{4.99\text{mol C}}{2.21\text{mol}} = 2.24 \times 4$$

$$4.48\text{g H} \times \frac{1\text{mol H}}{1.01\text{g}} = \frac{4.43\text{mol H}}{2.21\text{mol}} = 2 \times 4$$

$$35.5\text{g O} \times \frac{1\text{mol O}}{16.00\text{g}} = \frac{2.21\text{mol O}}{2.21\text{mol}} = 1 \times 4$$



$$9 (12\text{g}) \text{C}$$

$$8 (1\text{g}) \text{H}$$

$$4 (16\text{g}) \text{O}$$

$$\hline$$

$$180\text{g} - \text{Empirical mass}$$

$$\frac{180}{180} = 1$$

